Parasympathetic Involvement in Meal-Associated Conditioned Insulin Secretion

Strubbe, J.H.

Published in:
Diabetologia

Publication date:
1992

436

PARASYMPATHETIC INVOLVEMENT IN MEAL-ASSOCIATED CONDITIONED INSULIN SECRETION.

J.H.Strubbe. Department of Animal Physiology, Haren, The Netherlands.

During food intake vagally mediated insulin secretion plays a role in reducing blood glucose levels. The present study aims to investigate whether this insulin secretion can be conditioned. By clock-activated opening of doors in front of the food hopper rats were habituated to a feeding schedule of 6 meals in comparison with a schedule of 2 meals per day. Blood glucose and plasma insulin concentrations were measured in blood sampled via a permanently implanted cardiac catheter in freely moving rats. After opening of the doors insulin rapidly increased in the first minute during feeding in both conditions (16 ± 4 versus 33 ± 6 mU/L, $p < 0.05$, $n = 6$, for respectively the 6 and 2 meal schedule). After presenting an empty food hopper, insulin rose significantly in the first minute after opening of the door (31 ± 10 mU/L, $p < 0.05$) in the 2-meal/day condition but not in the 6-meal/day condition. This response was abolished following pharmacological blockade of nicotinic receptors by hexamethonium and muscarinic receptors with atropine. The present study shows that rapid conditioned insulin secretion can be evoked within 1 minute by a meal-associated stimulus. These results further indicate that this conditioned insulin secretion is vagally mediated and that its occurrence is dependent on the nature of the feeding schedule.

437

ROLE OF THE CENTRAL NERVOUS SYSTEM IN INCREASED PANCREATIC ISLET BLOOD FLOW OF OBESE RATS.

N. Atef, A. Ktorza, and L. Pénicaud. Lab. Physiopathol. Nutrition, CNRS URA 307, Paris, France

We have previously shown that pancreatic islet blood flow (IBF) was significantly higher both in the basal state and after an intravenous glucose load in obese than in lean Zucker rats. The aim of the present work, was to investigate whether the effect of glucose could be mediated by the central nervous system. Glucose (9 mg/kg) was injected towards the brain via a carotid artery in anesthetized lean and obese rats. IBF was determined by using the non radioactive microspheres technique. Glucose injection resulted in: 1) no significant changes of peripheral plasma glucose in both groups, 2) a similar increase above basal values of plasma insulin level (ΔI μU/ml lean 35±5, obese 46±6), 3) a higher increase of IBF in obese than in lean rats (ΔIBF μl/min: 203±38 vs 48±20). Both glucose-induced increase of plasma insulin and IBF were abolished by prior bilateral subdiaphragmatic vagotomy in lean rats and decreased significantly in comparison to basal values in obese rats. These data suggest that 1) the increased glucose induced IBF is mediated at least in part by a direct action of glucose in the brain 2) this central effect of glucose is abnormal in obese rats.

438

THE EFFECT OF ADRENODEMEDULLATION AND TRAINING ON INSULIN SECRETION AND GLUCOSE METABOLISM IN PANCREATIC ISLETS.

B. Stallknecht, M. Graversen, S.E. Hansen, K. Capito and H. Galbo. Depts. Biochemistry A, and Medical Physiology, The Panum Institute, University of Copenhagen, Denmark.

Chronical epinephrine treatment reduces the insulin response to glucose. Accordingly, we studied whether adrenomedullary hormones are responsible for the diminished glucose induced insulin secretion seen after training. To further elucidate the mechanism for this adaptation we also measured beta-cell glucose metabolism. Rats were adrenodemedullated (ADM) or shamoperated (C) and either swimtrained for 10 wks (T) or sedentary (S). At sacrifice body weight was lower ($p < 0.05$) in T than in S groups (412 ± 11 (SE) g (ADMT, $n = 8$), 378 ± 10 (CT, $n = 8$), 476 ± 20 (ADMS, $n = 8$), 509 ± 20 (CS, $n = 8$). Pancreatic islets were incubated at 3,10 and 20 mM glucose and insulin, $^{3}H_2O$ (from 5-^{3}H-glucose, overall glycolysis) and $^{14}CO_2$ (from U-^{14}C-glucose, glucose oxidation) were measured. In ADMS rats insulin secretion was increased ($p < 0.05$) at 3 mM (68 ± 7 ng/ml/5 islets/2 h vs 37 ± 5 (CS), 26 ± 8 (ADMT), 32 ± 7 (CT)). Insulin response was similarly depressed ($p < 0.05$) in both trained groups (at 10 mM: 49 ± 10 (ADMT), 50 ± 8 (CT) vs 69 ± 7 (CS), 62 ± 9 (ADMS). Glycolysis was higher ($p < 0.05$) in CT (3-10-20 mM: 914 ± 110, 2594 ± 415, 3764 ± 578 pmol/10 islets/2 h) than in CS (567 ± 134, 1173 ± 322, 1968 ± 264) rats and never affected by demedullation. Glucose oxidation showed the same pattern. Conclusions: Adrenomedullary hormones normally exert a trophic depression on basal beta-cell secretion but do not account for the training induced decrease in glucose stimulated insulin secretion. The latter is, surprisingly, accompanied by a training induced increase in beta-cell glucose metabolism.

439

DIETARY RESTRICTION AMELIORATES IMPAIRED INSULIN SECRETION IN ISOLATED ISLETS OF AGING RATS.

M. Bombara, M. Novelli, P. Masiello and E. Bergamini. Istituto di Patologia Generale, University of Pisa, Italy.

To explore the influence of a dietary restriction known to increase longevity in rodents (intermittent feeding), on the impairment in insulin secretory responsiveness of aging rats, islets were isolated from 25-mo-old Sprague-Dawley rats, fed either ad libitum (controls) or every other day (IF) over 22 months. During a 60-min static incubation, insulin release in IF islets was lower than in control islets at 2.8 mmol/l glucose (2.4 ± 0.2 versus 3.6 ± 0.5 ng/islet, $p < 0.05$) and higher at 16.7 mmol/l glucose (11.0 ± 1.8 versus 4.3 ± 0.7 ng/islet, $p < 0.01$). Furthermore, a clear-cut improvement of the secretory effectiveness was found in IF islets, in comparison with control islets, stimulated by either 20 mmol/l 2-ketoisocaproate (12.8 ± 1.2 versus 4.5 ± 0.4 ng/islet, $p < 0.01$, at 2.8 mmol/l glucose and 17.2 ± 1.8 versus 6.0 ± 1.3 ng/islet, $p < 0.01$, at 16.7 mmol/l glucose), or 20 mmol/l arginine plus glucose (13.3 ± 0.7 versus 5.6 ± 0.8 ng/islet, $p < 0.01$) or 1 mmol/l isobutylmethylxanthine plus glucose (20.6 ± 2.3 versus 7.1 ± 0.9 ng/islet, $p < 0.01$). Indeed, the feature of insulin scretory response of islets from IF aging rats is similar to that occurring in young animals. Immunoreactive insulin and glucagon content were higher in IF than in control islets (IRI, 446 ± 12 versus 356 ± 16 ng/islet, $p < 0.01$; IRG, 8.4 ± 0.6 versus 5.1 ± 0.2 ng/islet, $p < 0.01$). In conclusion, IF prevents the decline in insulin secretory efficiency of aging rats.